Endosymbiotic Gene Transfer and the Evolution of the First Photosynthetic Eukaryotes

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Horizontal gene transfer, or the introduction of genes across the "branches" of the tree of life rather than through normal vertical evolution, has been proven in prokaryotes but is yet to be rigorously tested in eukaryotes. Our research focuses on one special case of horizontal gene transfer that we postulate to have played a fundamental role in early eukaryotic evolution - endosymbiotic gene transfer. The cyanobacterial endosymbiosis that gave rise to the first plastid in a monophyletic group of algae and plants termed the Plantae is an ancient event in eukaryotic history (~1.5 billion years ago). Endosymbiosis left a sizeable mark on the nuclear genome that goes well beyond the lateral transfer of photosynthetic capacity. Analysis of the Arabidopsis nuclear genome suggests that about 18% of this plant's nuclear genes, many of non-photosynthetic function (e.g., disease resistance), originated from the cyanobacterium. Endosymbiotic gene transfer significantly enriches nuclear genomes with foreign genes which selection can act on to explore novel functions. To quantify this critical process, we are generating 11,000 expressed sequence tags (ESTs) from an early diverging alga within the Plantae, Cyanophora paradoxa (Glaucophyta). Normalization and subtraction protocols are being used to maximize the novelty of the cDNA data set. The project relies on initial gene identification using our high-throughput sequencing and bioinformatic pipeline followed by sequencing and phylogenomic analysis of selected cDNAs to reveal their evolutionary origin (see figure). In this talk, we will present the results of preliminary analyses of the start and normalized cDNA libraries from Cyanophora.